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Abstract

FAST POWER REACTORS

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The development of Fast Power Reactors continues to be motivated by their capability to breed and thus achieve efficient utilization of nuclear resources. This capability has been placed in better perspective since the 1958 Geneva Conference as a result of estimates which have been made of future power requirements in the United States and the role of nuclear power in meeting these requirements. These estimates indicate that Fast Reactors will be needed in the 1980's. The U. S. program is directed toward the development of Fast Reactors which will be compatible with electric generating system requirements at that time.

It has been estimated that the present trend toward larger power stations will continue and that in about 20 years stations of approximately 1000 MWe size will be desired. The U. S. program has been altered to emphasize the development of these large plants. Four independent design studies of 1000 MWe Fast Reactor Power Plants were recently completed for the U. S. Atomic Energy Commission. This paper reviews these studies with particular emphasis on the indicated trends in reactor design and the indicated future development requirements.

The major fast reactor facilities now available in the U. S. are the EBR-II and Enrico Fermi Atomic Power Plant. Construction of these facilities has been completed and initial operation has commenced. Difficulties were encountered which delayed their operation but indirectly this experience contributed significantly to the technology. In particular, valuable maintenance experience has been obtained with the sodium systems. At EBR-II, the primary sodium pumps, a control drive, the fuel gripper, and other

mechanisms have been removed from the sodium system. At Fermi, pumps, steam generator internals, and the offset handling mechanism in the fuel handling system also have been removed. All of these operations were performed without violating the inert gas atmosphere or significant contamination of the sodium. Special procedures were developed for these operations which will be described. In addition, major repairs and modifications were made inside the Fermi reactor vessel after draining the sodium. This was accomplished with a minimum of contamination of the inert gas environment by men working in air-tight suits with external air supplies.

The experience with sodium filling and sodium system operation has been extremely encouraging. The 80 000 gallon EBR-II primary system was filled without incident and sodium quality has been maintained without difficulty. The same filling experience was obtained at Fermi and while some contamination with oxygen, hydrogen, and carbon occurred during preoperational testing, it was removed without difficulty. At no time was difficulty experienced with plugging of systems in either facility.

All of this experience was obtained on large components and systems and is applicable to power station operation. It is particularly relevant to the plans for larger plants involving larger capital investments.

The initial performance of both EBR-II and Fermi have been very encouraging. There has been excellent correlation between predicted performance and actual results. This applies equally to those parameters that were checked by critical experiments such as critical mass and control rod worth as well as those dependent primarily on analysis such as temperature coefficients and sodium coefficients. The nuclear characteristics were found to be as predicted and indicate that acceptable power performance can be expected.

Power operation of these facilities will provide additional data and experience, including power induced reactivity effects, irradiation data and over-all plant operational experience. Current status and operating data as well as future programs for these facilities are described.